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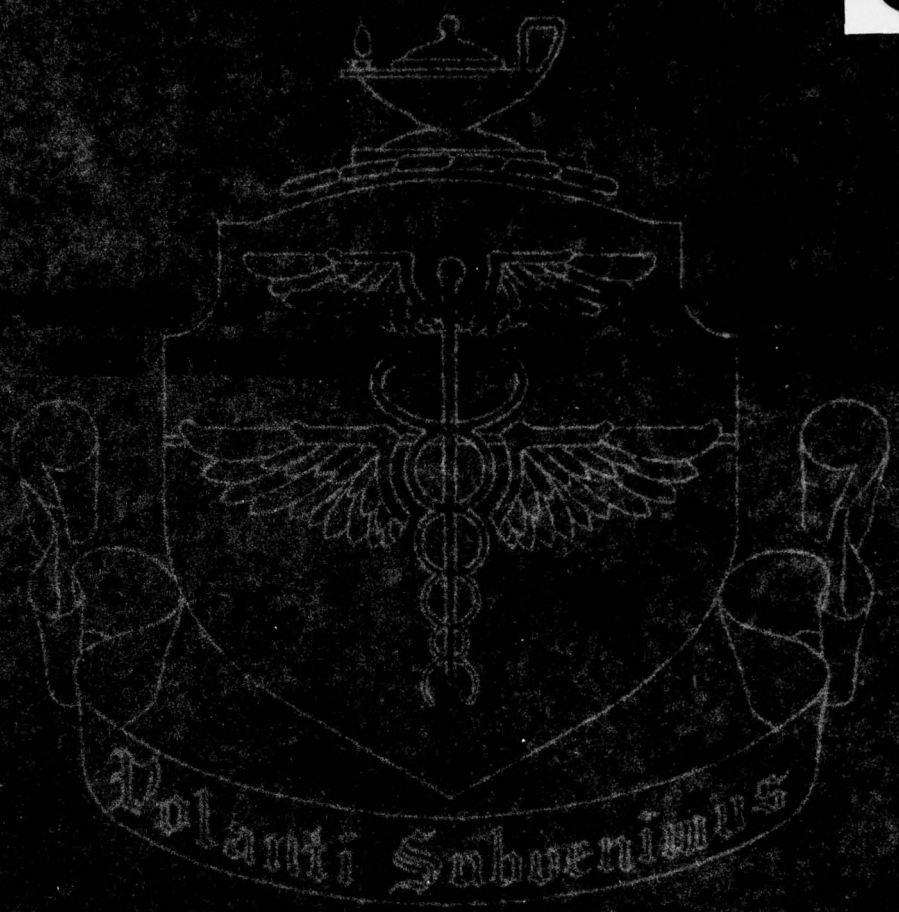

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TRANSPOSITION OF RESPONSE TO THE INTERMEDIATE-SIZE STIMULUS IN RHESUS MONKEYS

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TRANSPOSITION OF RESPONSE TO THE INTERMEDIATE-SIZE STIMULUS IN RHESUS MONKEYS

Eight rhesus monkeys were trained to choose the intermediate of three different size stimuli. During transposition testing, stimuli were employed which favored no single choice based on "absolute" stimulus values. When response eliciting values dependent on "absolute" stimulus properties were balanced in this manner, sophisticated rhesus monkeys were observed to base responses on "relational" properties of the test stimuli.

Whereas Spence (3, 4) has demonstrated that an "absolute" type theory of discrimination learning can predict continued choice of the "larger" of *two* stimuli during transposition testing, he concludes that choice of the intermediate-size stimulus in a three-stimulus problem should provide a more critical test of his "absolute" type theory of discrimination. Spence (4) trained six chimpanzees to choose the intermediate of three different size stimuli. During transposition testing, stimulus values were shifted so that the intermediate training stimulus became the smallest stimulus of the test set, and the largest stimulus of the training set became the intermediate-size stimulus of the test set. Thus, the Ss were given the choice between an intermediate-size stimulus which had been nonrewarded during training and a nonintermediate-size stimulus which had been rewarded during training. The chimpanzees were strong in their preference for the stimulus object which had been positive during training, apparently disregarding its nonintermediate relation in the test set.

Gonzales et al. (2) refined the transposition-testing paradigm to maximize sensitivity to "relational" tendencies which might be present in choice of the intermediate-size stimulus. Four chimpanzees were trained to choose the intermediate of three different size stimuli. During transposition testing, stimulus values were shifted so that the intermediate-size stimulus of each test set and one of the nonintermediate test stimuli were equidistant along the size continuum from the "absolute" value of the positive training stimulus. In terms of an "absolute" type theory of discrimination, responses of the Ss should have been equally distributed between the test stimuli which were equally distant from the positive training stimulus. Actually, the four chimpanzees demonstrated a significant preference for the test stimulus which appeared intermediate in size in its test set.

Apparently, the chimpanzee responds to "absolute" stimulus values rather than to relations between stimuli when allowed to choose between the two solutions; however, when "absolute" stimulus values determine no distinct preference, responses suggest that the chimpanzee has learned something about relationships between the stimuli. Because transposition of the intermediate-size choice appears critical for theories of discrimination learning, the present experiment was undertaken to verify the "relational learning" observed by Gonzales et al. (2) and to extend the demonstration of "relational" choice to the rhesus monkey, a species somewhat further removed from man than the chimpanzee.

METHOD

Subjects

This report, which is concerned solely with the problem of discrimination learning, discusses the performance of eight normal, non-

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This work was accomplished at the Radiobiological Laboratory of the University of Texas and the United States Air Force, Austin, Tex.

irradiated control animals belonging to a larger group maintained at this laboratory for investigation of the effects of chronic, whole-body irradiation. These Ss were about 5 years old at the start of the experiment and represented the most highly sophisticated monkeys available at this laboratory, having had more than three years of experience in a variety of psychologic experiments. The monkeys were housed indoors in air-conditioned quarters and worked five days a week. In addition to raisins, apples, peanuts, and corn received as incentives during testing, they were fed in their home cages at the close of each work day.

Apparatus

A string-pulling apparatus was employed throughout the experiment. The stimuli presented on each trial were mounted on tracks and equipped with strings by which they could be drawn within reach by the S.

The stimuli were cubical wooden boxes, each of which was open at the top and painted black both inside and out. The boxes were designated in order of size with the numbers 1 to 9. Each face of the smallest box was 9 sq. in. in area, and the size of each successive box in the series increased by a factor of 1.15.

Procedure

Each monkey was first trained to a criterion of 16 out of 18 correct responses to choose the intermediate size of stimulus set 1, 5, 9. Eighteen trials were given each day and the correction method was employed throughout the experiment. The spatial arrangement of the three boxes was randomly varied. Following training on 1, 5, 9, the discrimination was sharpened by training to the same criterion on stimulus values 3, 5, 7 with the intermediate size positive on each trial.

The test for transposition involved two new sets of stimuli — 2, 4, 6, and 4, 6, 8. In each case, stimuli 4 and 6, presented on each test trial, were constructed to differ from the positive training stimulus by equal size ratios (1:15). Transposition testing was accomplished in four days. Each day, 12 trials involved continued training on stimulus set 3, 5, 7 with the intermediate-size stimulus rewarded. Interspersed among the training trials each day were six test trials—three with 2, 4, 6, and three with 4, 6, 8. On test trials any choice was rewarded. In four days of testing, each test set was presented 12 times, twice in each of the six possible spatial arrangements.

RESULTS AND DISCUSSION

Table I presents the distribution of responses to stimuli of each test set for the eight normal, sophisticated rhesus monkeys of this experiment. On the 24 test trials, the mean number of responses to the intermediate-size stimulus was 17.8. Since no theory of discrimination learning would predict choice of extreme stimulus values 2 and 8, a chance distribution of responses should result in approximately 12 out of 24 choices of the intermediate size. The preference for the intermediate-size stimulus demonstrated by the Ss of this experiment is greater than chance at the .001 level of significance (1), as indicated by a t-test of the hypothesis that the sample values were drawn from a population with a mean of 12.0.

Choice of the intermediate-size stimulus, disregarding absolute stimulus values, should result in an equal distribution of responses between stimuli 4 and 6; however, if either stimulus 4 or 6 were *psychologically* closer to 5, an unequal distribution should result from "absolute" response tendencies. The mean numbers of choices of test stimuli 4 and 6 were 11.9 and 11.1, respectively. These values do not differ from chance to any significant degree.

Above chance response to the intermediate-size stimulus on transposition test trials indicates that rhesus monkeys do learn stimulus relationships during discrimination training. During training on the intermediate-size discrimination problem, the hypothetic gradients of excitation and inhibition which are established should be symmetric about stimulus 5.

TABLE I

Distribution of responses of eight rhesus monkeys on 24 test trials

Animal		Number of choices of each stimulus				Number of choices of the intermediate-size stimulus
		No. 2	No. 4	No. 6	No. 8	
1	Set 2, 4, 6	2	9	1		
	Set 4, 6, 8		4	8	0	17
2	Set 2, 4, 6	0	10	2		
	Set 4, 6, 8		2	10	0	20
3	Set 2, 4, 6	0	10	2		
	Set 4, 6, 8		4	8	0	18
4	Set 2, 4, 6	1	8	3		
	Set 4, 6, 8		3	8	1	16
5	Set 2, 4, 6	2	8	2		
	Set 4, 6, 8		3	9	0	17
6	Set 2, 4, 6	0	7	5		
	Set 4, 6, 8		4	8	0	15
7	Set 2, 4, 6	2	10	0		
	Set 4, 6, 8		2	10	0	20
8	Set 2, 4, 6	0	9	3		
	Set 4, 6, 8		2	10	0	19
Total		7	95	89	1	142

To the extent that test stimuli 4 and 6 are functionally equidistant from 5 along the size continuum, the strengths of response tendencies based on "absolute" stimulus properties should approach equality. When response tendencies based on "absolute" stimulus values are equated, rhesus monkeys demonstrate significant "relational learning." Thus, the results of the present experiment confirm results obtained by Gonzales et al. (2) with chimpanzees and extend the findings to a lower primate form.

SUMMARY

Eight rhesus monkeys were trained to choose the intermediate of three different size stimuli. During transposition testing, stimuli were employed which favored no single choice based on "absolute" stimulus values. When response eliciting values dependent on "absolute" stimulus properties were balanced in this manner, sophisticated rhesus monkeys were observed to base responses on "relational" properties of the test stimuli.

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